"The Model-driven Approach to Geographic Information System Standardisation - Lessons Learned - "

www. isotc211.org

Dr. Arne J. Berre
SINTEF, Oslo, Norway
Distributed Information Systems
Phone: (+47) 22 06 74 52
E.mail:Arne.J.Berre@informatics.sintef.no

Open GIS Consortium
Spatial connectivity
for a changing world.

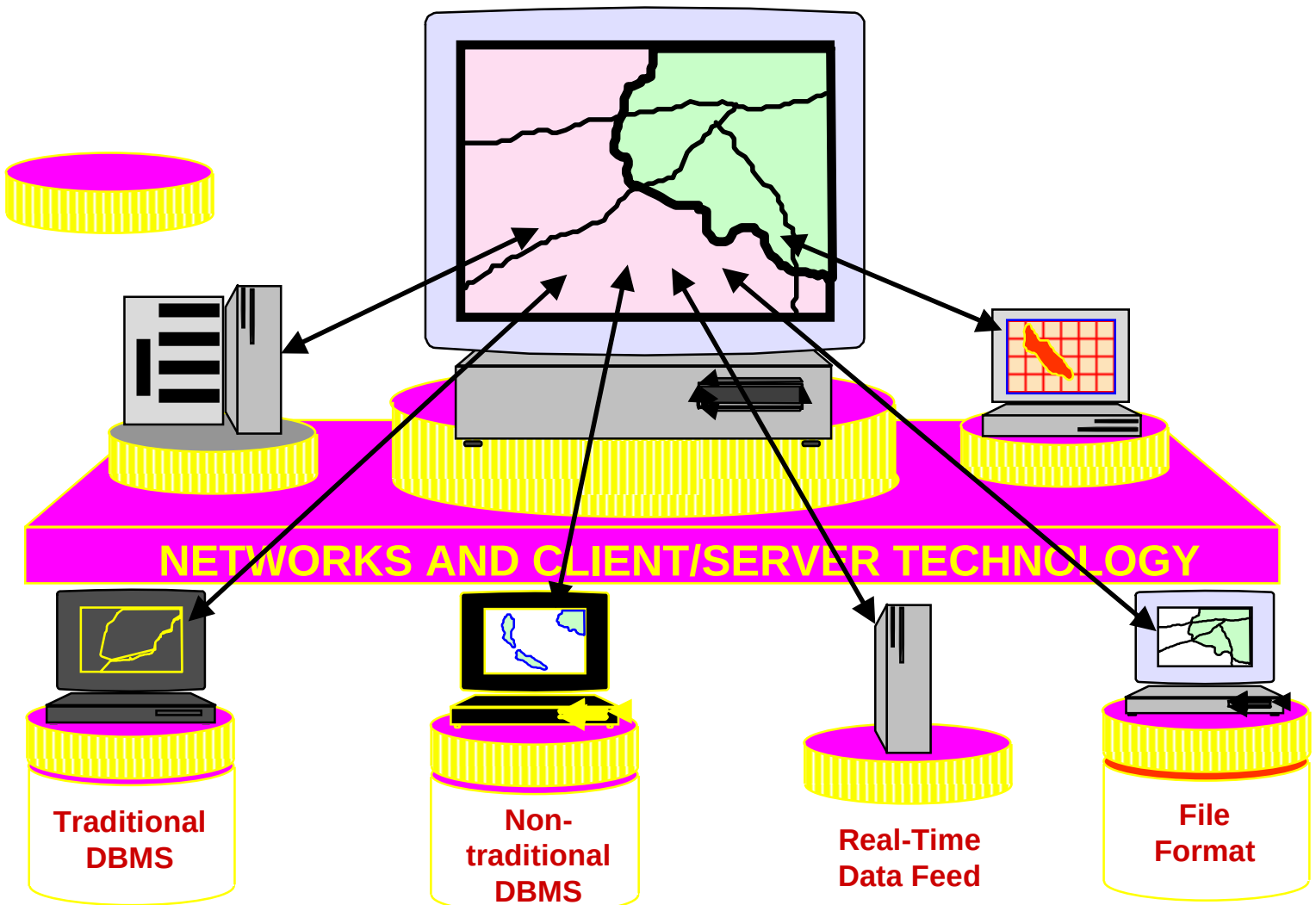
www. opengis.org

- **Problem: Interoperability of GIS – through standards**
- **Requirement: For data and services**
- **ISO solution: ISO/TC211 modeling approach – ISO 191XX series**
  - **ISO 19101, 19103, 19119, 19109, 19118**
- **OGC solution – Open Geodata Consortium – standard approach**
  - **GML 1.0, 2.0, 3.0, Abstract and Implementation specifications**
- **Lessons learned: The conflict - Specification vs Implementation + tools**
- **What should be done next: PIM-PSM mapping standards/tools, 'HUTN XMI'**

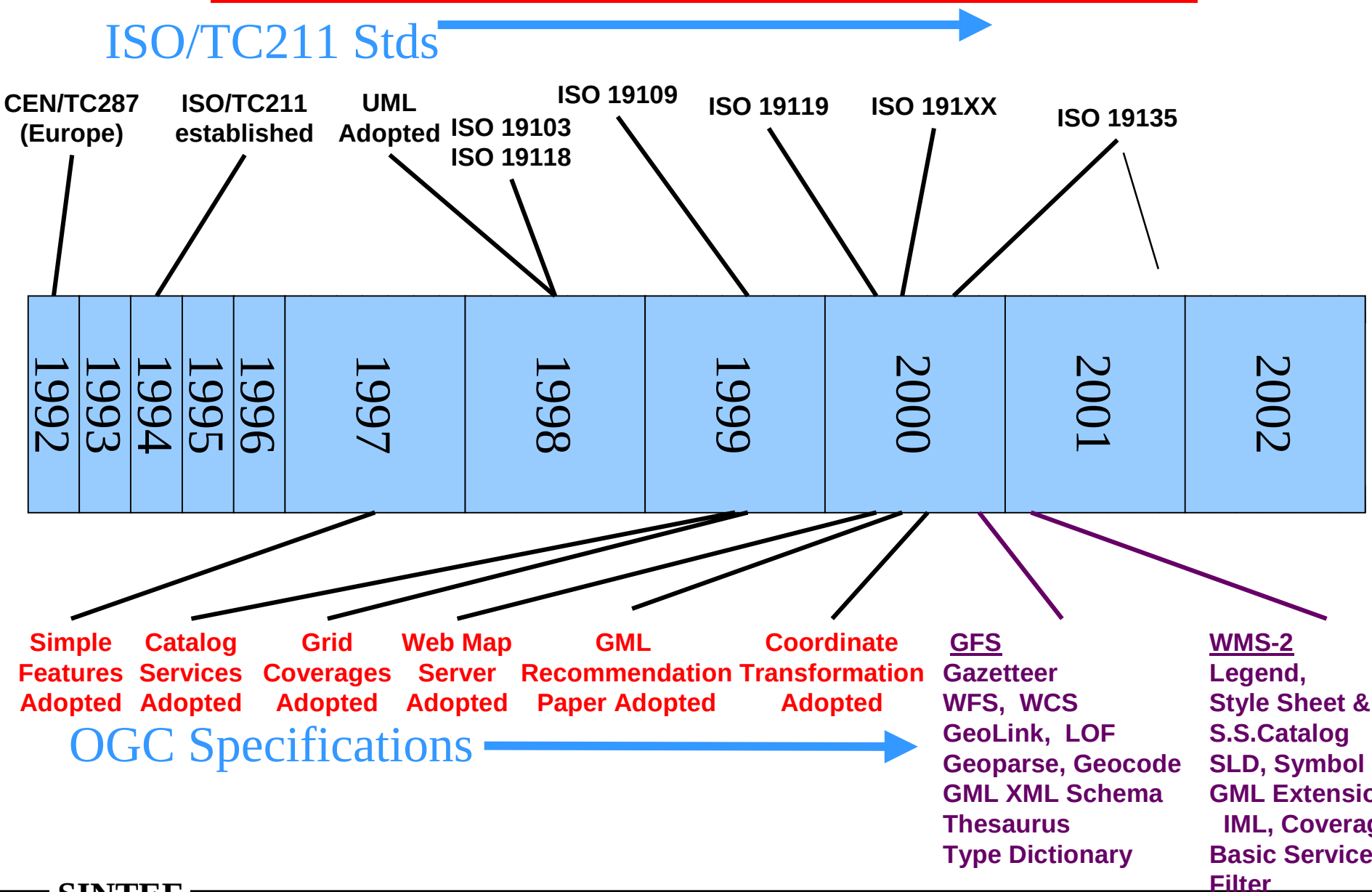
Abstract

Since 1995 the two main standardisation organisations for Geographic Information, ISO/TC211 and OGC (Open Geodata Consortium) have worked on the specification of standards for geographic data and services. UML has been selected as the normative specification language within ISO/TC211 since 1998, while OGC is currently using UML in a non-normative way. ISO/TC211 focuses on platform independent models expressed in UML, and on a model-driven approach for mapping these to XML, while OGC is addressing implementation specifications for multiple technologies. Currently it has not been possible to fully realise the model-driven approach to standard specifications across ISO/TC211 and OGC. An analysis of the current situation, and requirements for what needs to be done to achieve this, will be presented.

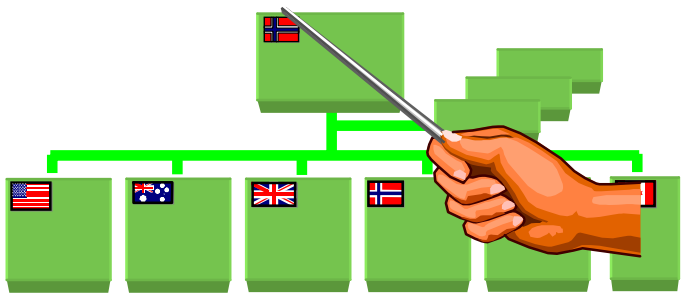
Problem Goal: Transparent Access to Heterogeneous Geodata and Geoprocessing Services



ISO/TC211 & OGC "Roadmap"



ISO/TC211Overview

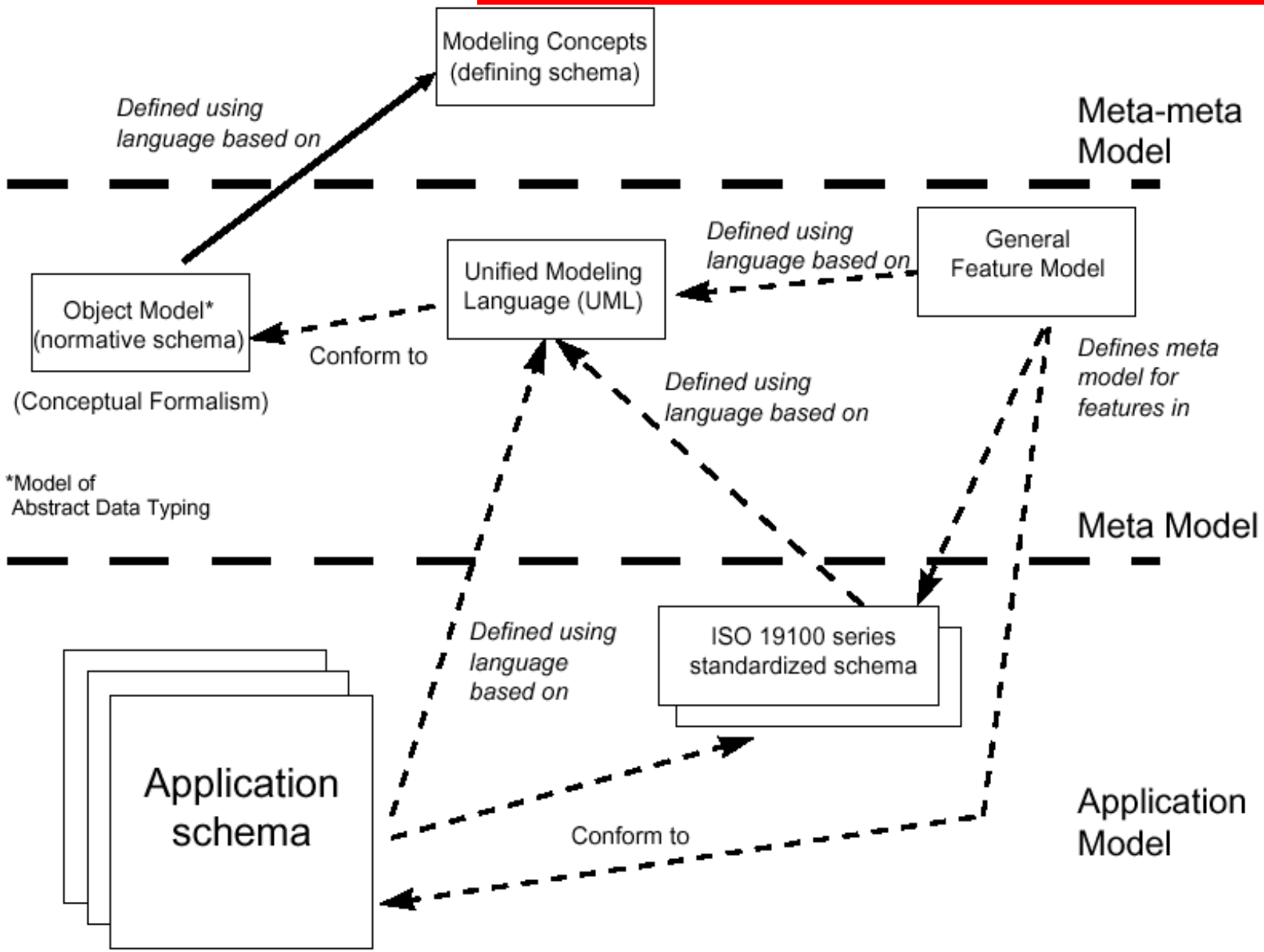


- ISO 19101 - Reference model
- ISO 19102 - Overview
- ISO 19103 - Conceptual schema language
- ISO 19104 - Terminology
- ISO 19105 - Conformance and testing
- ISO 19106 - Profiles
- ISO 19107 - Spatial schema
- ISO 19108 - Temporal schema
- ISO 19109 - Rules for application schema
- ISO 19110 - Feature cataloguing methodology
- ISO 19111 - Spatial referencing by coordinates
- ISO 19112 - Spatial referencing by geographic identifiers
- ISO 19113 - Quality principles
- ISO 19114 - Quality evaluation procedures
- ISO 19115 - Metadata
- ISO 19116 - Positioning services
- ISO 19117 - Portrayal
- ISO 19118 - Encoding
- ISO 19119 - Services
- ISO/TR 19120 - Functional standards + new rev
- ISO/TR 19121 Imagery and gridded data
- ISO/TR 19122 - Qualifications and certification of personnel
- ISO 19123 - Schema for coverage geometry and functions
- ISO 19124 - Imagery and gridded data components
- ISO 19125 - Simple feature access – Part 1-3
- ISO 19126 - Profile - FACC Data Dictionary
- ISO 19127 - Geodetic codes and parameters
- ISO 19128 - Web Map Server Interface
- ISO 19129 - Imagery, gridded and coverage data framework
- ISO 19130 - Sensor and data model for imagery and gridded data
- ISO 19131 - Data product specification
- ISO 19132 - Location based services possible standards
- ISO 19133 - Location based services tracking and navigation
- ISO 19134 - Multimodal location based services for routing and navigation
- ISO 19135 - Procedures for registration of geographic information items

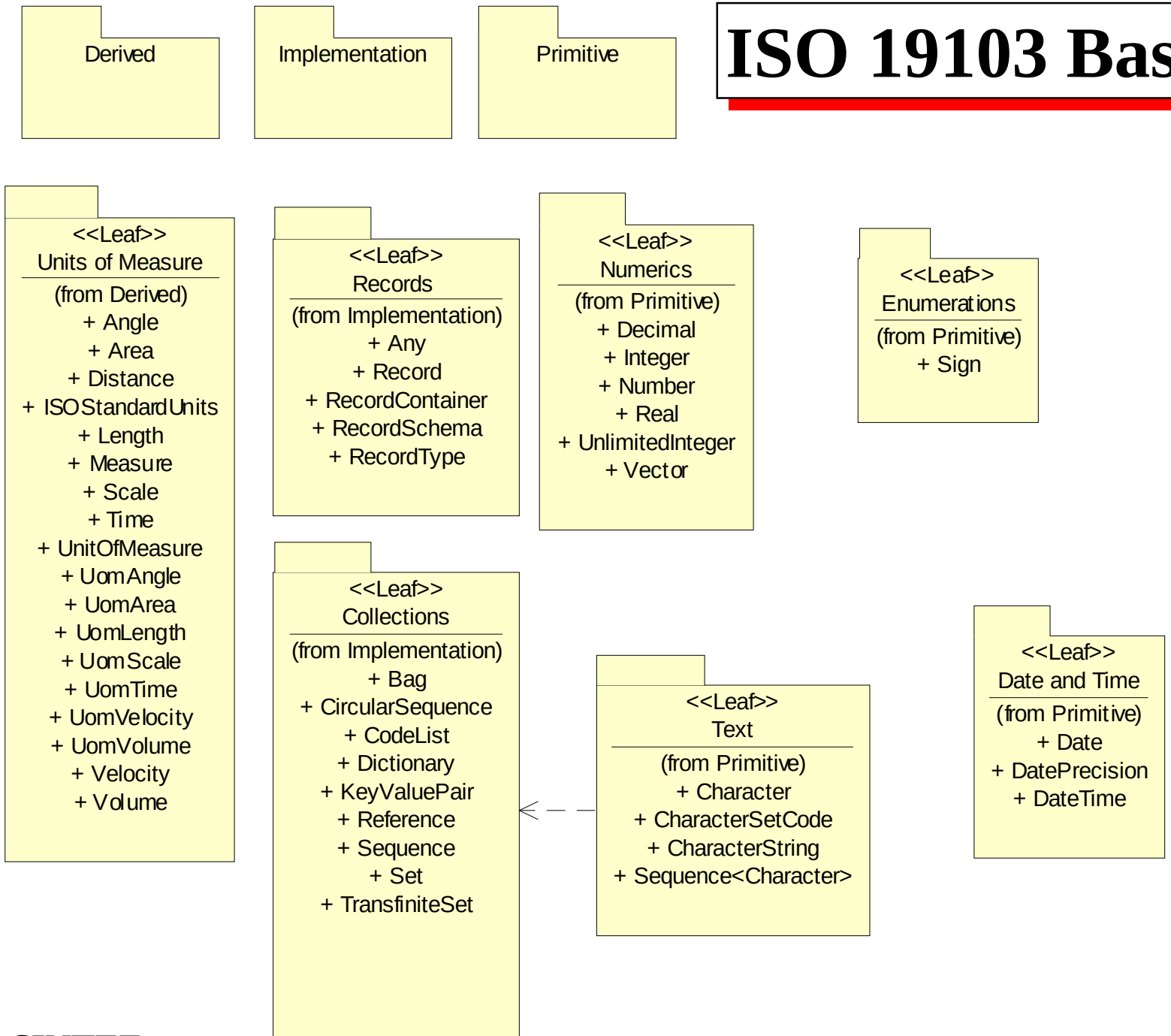
ISO 19103 – Conceptual Schema Language (UML)

- Basic data types
- Stereotypes
- Naming
- Documentation of models
- Implementation neutral vs implementation specific models
- Information modeling guidelines

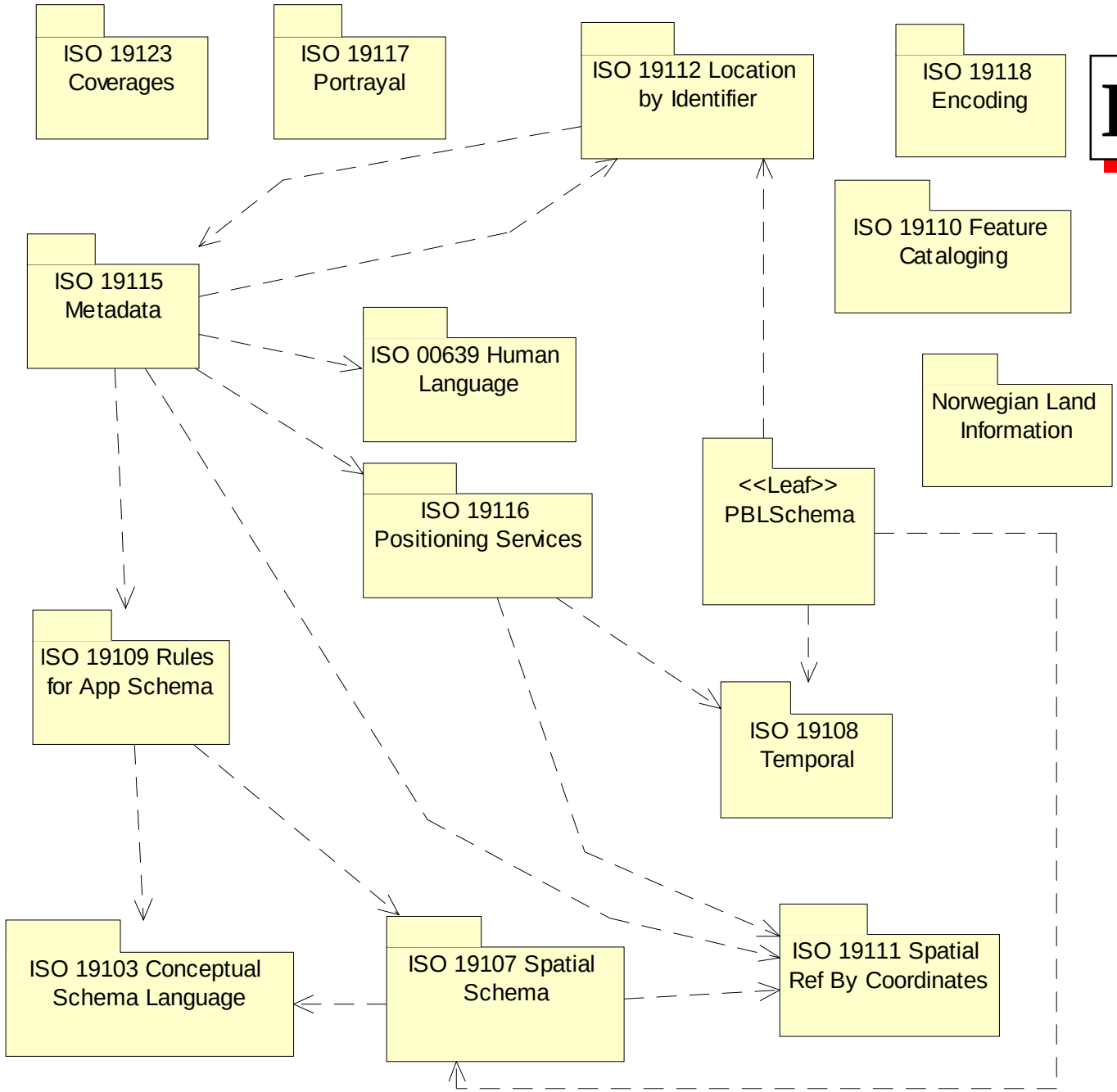
General Feature meta model



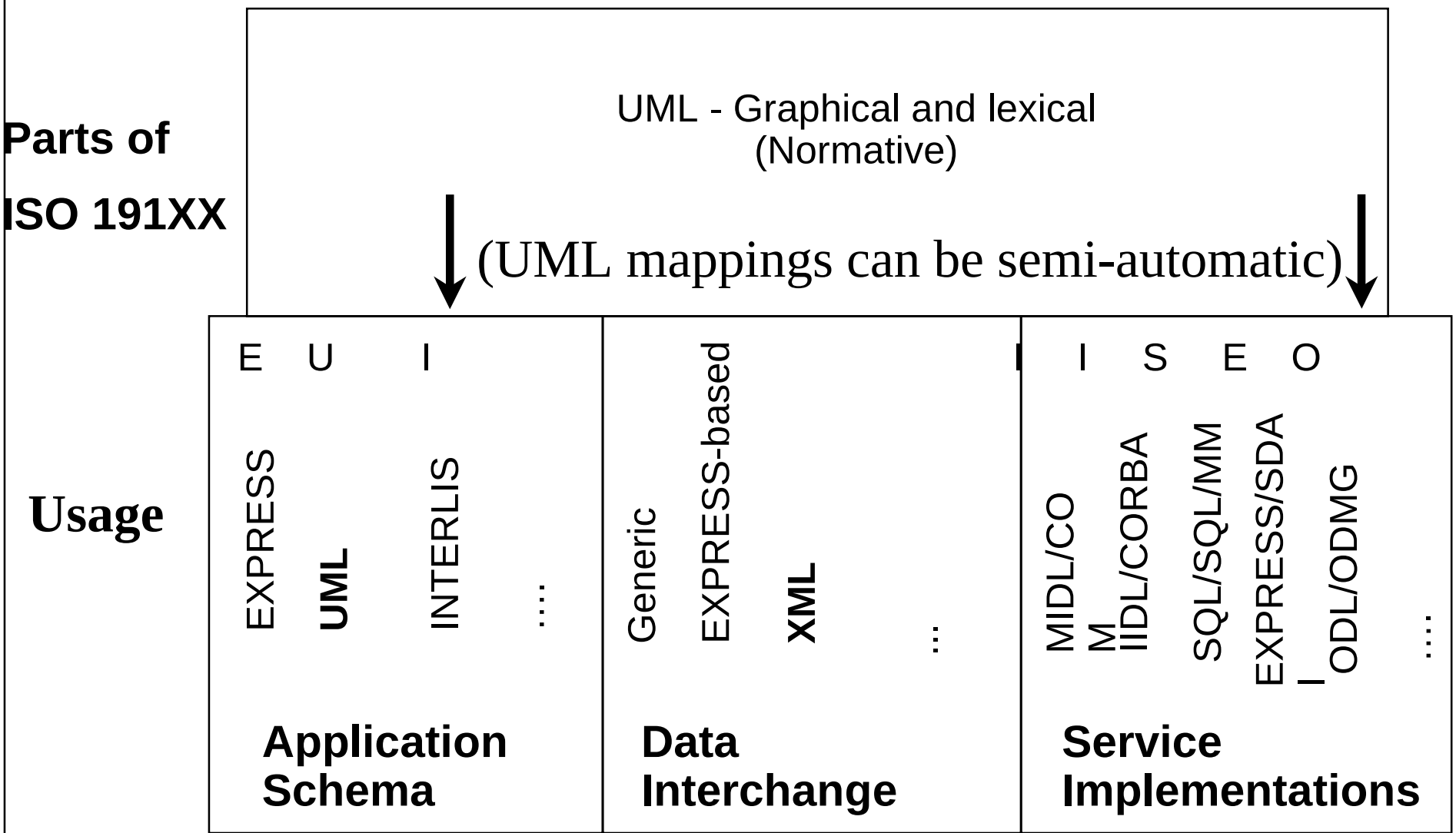
ISO 19103 Base Types



ISO Packages

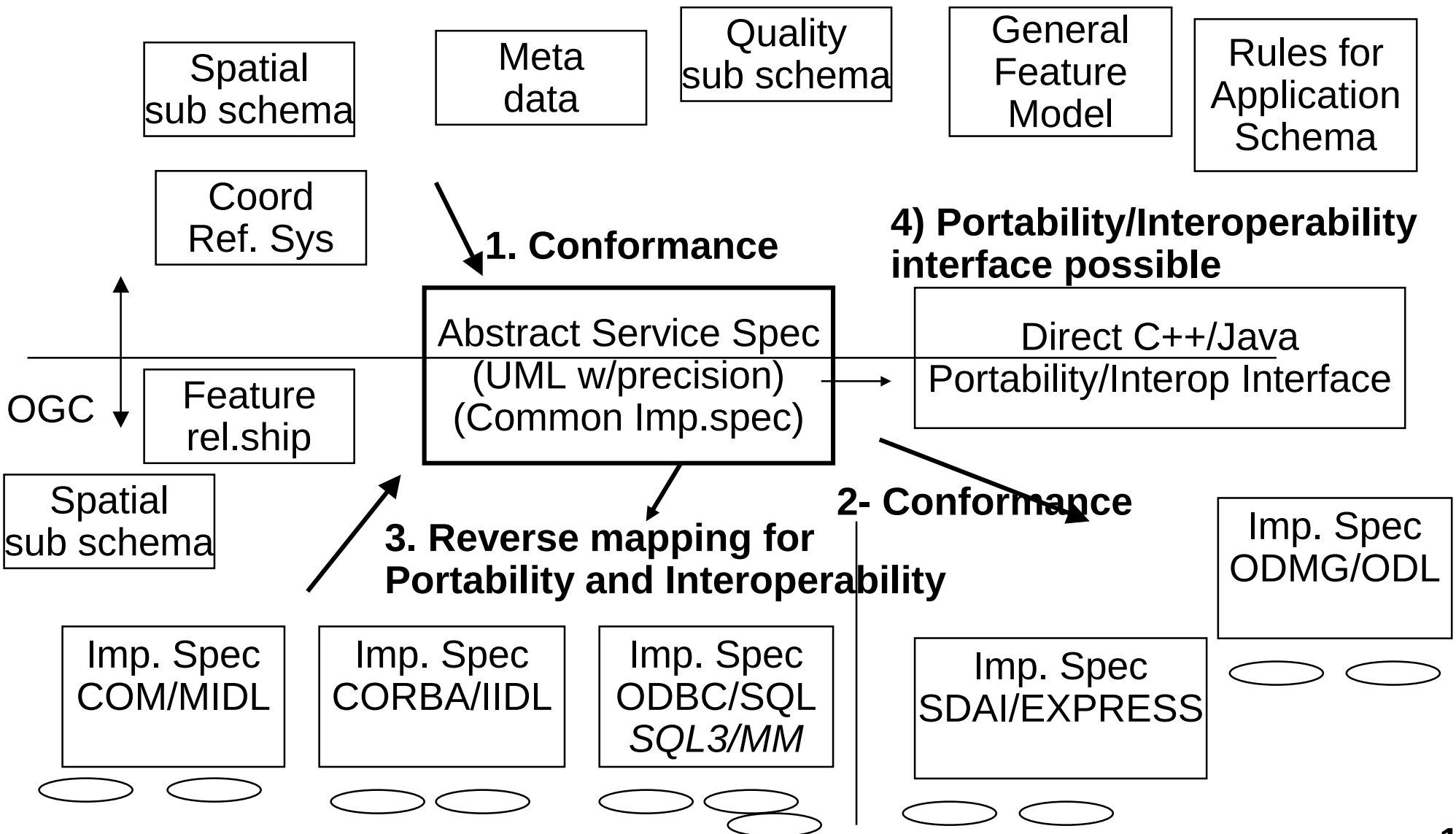


UML as a basis for multiple representations



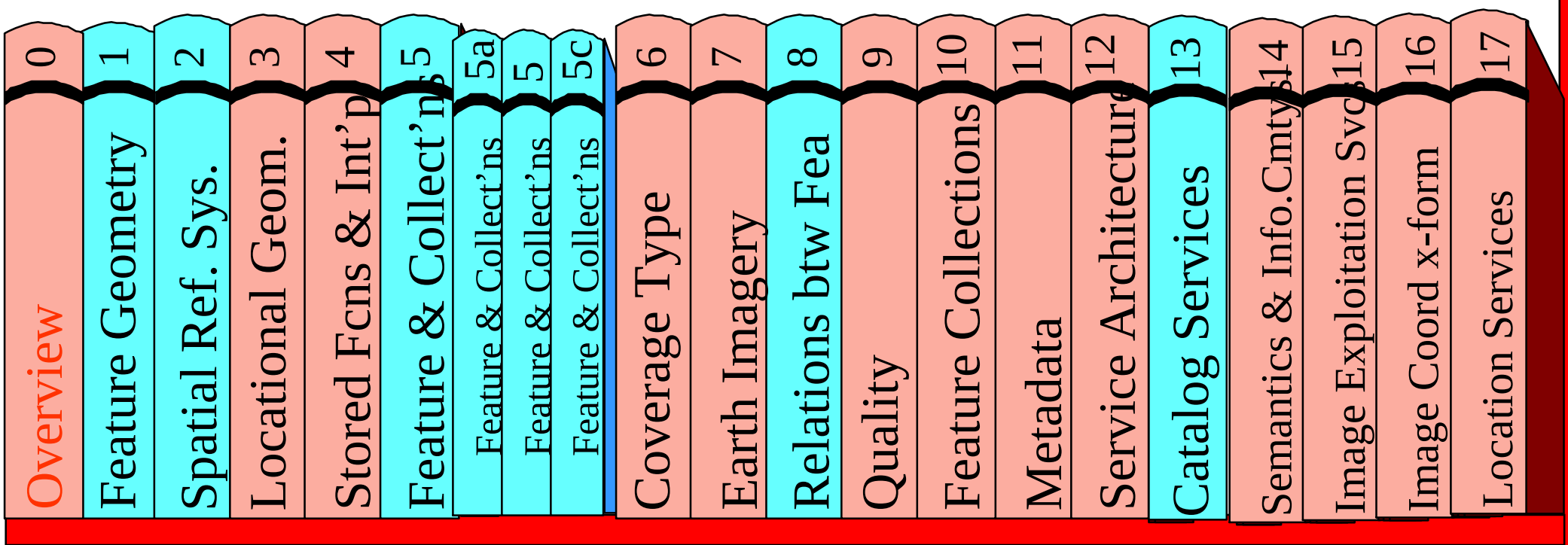
ISO

ISO/TC211-19119 and OpenGIS – ”vision”



The OpenGIS Abstract Specification

informal text and diagrams (Syntropy/UML)



Open GIS Consortium

Spatial connectivity

for a changing world.

Achievements: Implementation Specifications

1. OpenGIS® Simple Feature Access Interfaces
    1. SQL
    2. COM/OLE
    3. CORBA
2. OpenGIS® Catalog Service Interfaces
3. OpenGIS® Coordinate Transformation Services
4. OpenGIS® Grid Coverage Service Interfaces
5. OpenGIS® Web Map Server Interfaces
6. OpenGIS® Geography Markup Language (GML)

Implementation Specifications Expected Soon

7. Location Client
8. Data/Service Registry
9. Gazetteer Server
10. Yellow Page Server
11. Web Feature Server
12. Web Coverage Server
13. Data/Service Registries/Repositories
14. Gateway Services
15. Route Servers
16. Geocoder
17. Geoparser
18. Style Layer Descriptor/Legends
19. Search and Mining

OGC Trends

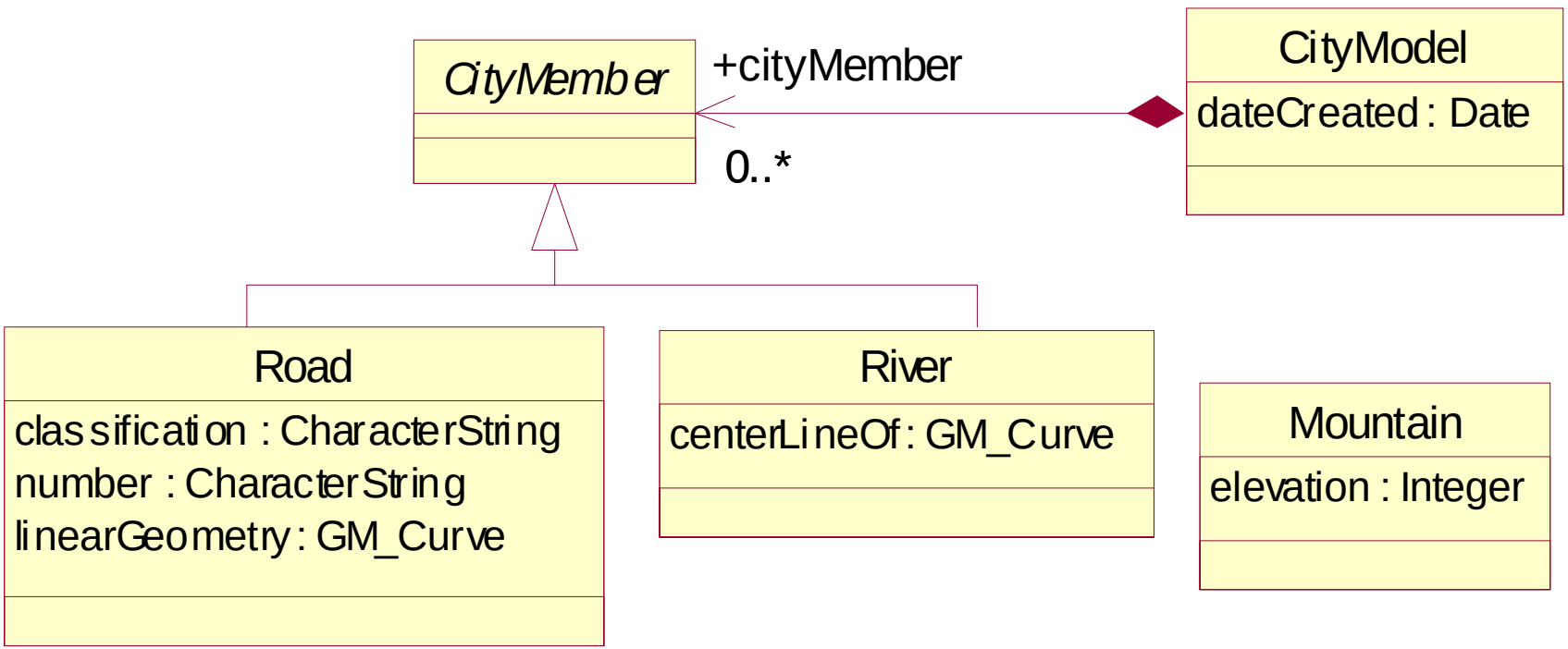
OLD

- GIS . . . . . .
- Government Led . . . . . .
- Stand-Alone Spatial Services . . .
- Focus on Portrayal & Analysis . . .
- De Jure Standards . . . . . .
- *Abstract Specifications* . . . . . .
- Custom/ Proprietary Identifiers . . .
- *Expert Driven* . . . . . .
- Isolated GIS Services . . . . . .

NEW

- Location-Based Services
- Industry Led
- Spatial Services Integrated into Business Objects
- Focus on Position & Navigation
- Industry Consensus Standards
- *Implementation Details*
- XML and GML
- *Market Driven*
- In Command and Control Loop

Example UML model



simpleXMI - reducing the complexity of XMI

```
<class name="Road" superClass="CityFeature" abstract="false">
        <attribute name="classification" type="CharacterString"/>
        <attribute name="number" type="CharacterString"/>
        <attribute name="linearGeometry" type="GM_Curve"/>
</class>
<class name="River" superClass="CityFeature" abstract="false">
        <attribute name="centerLineOf" type="GM_Curve"/>
</class>
<class name="CityModel" abstract="false">
        <attribute name="dateCreated" type="Date"/>
        <relationship name="cityMember" otherClass="CityFeature"
                cardinality="0..*" collectionType="set"
                aggregationType="composite"/>
</class>
```

ISO 19118 encoding – based on the simple XMI approach

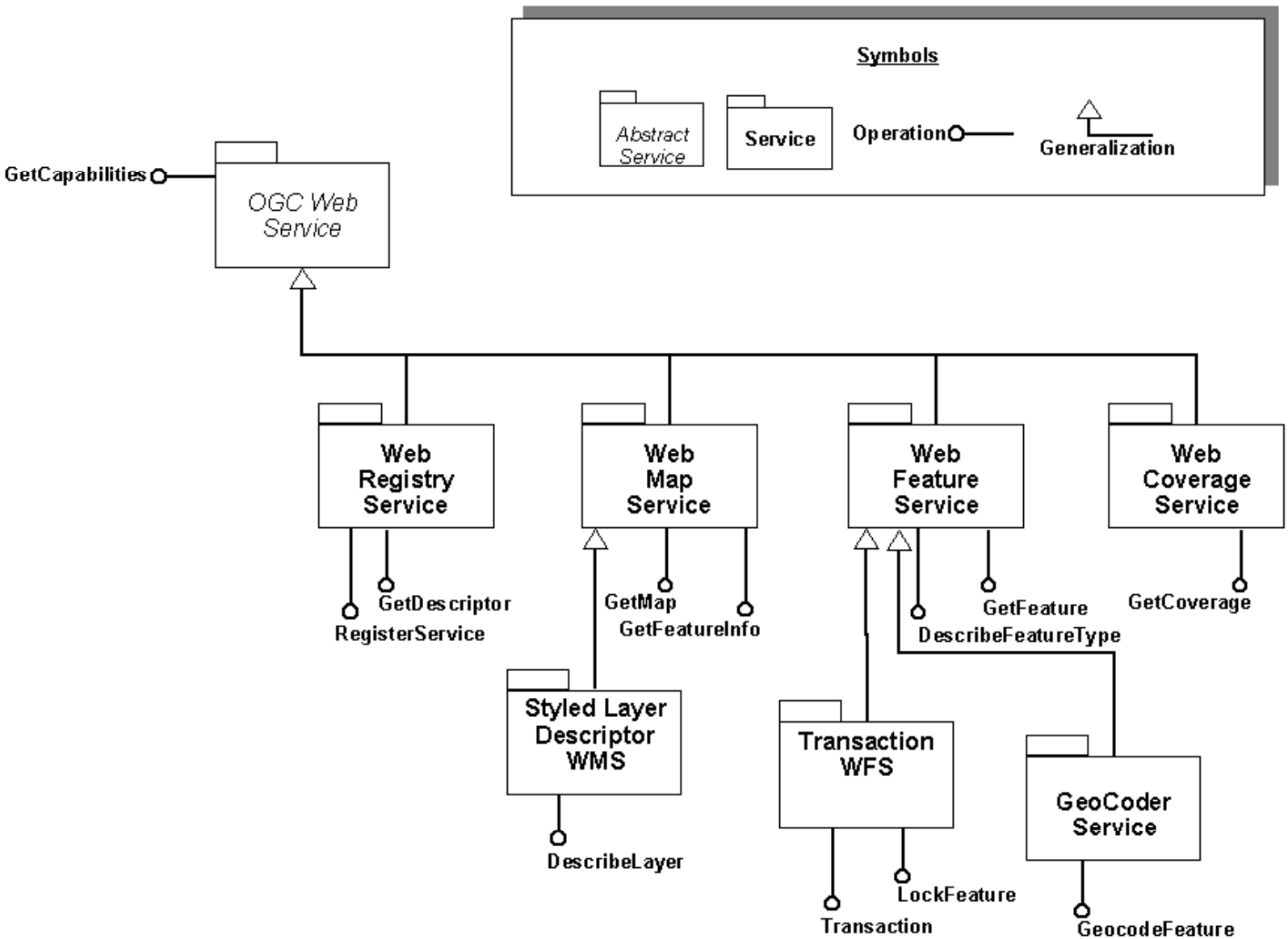
```
<complexType name="Road">
        <sequence>
            <element name="classification"
type="CharacterString"/>
            <element name="number" type="CharacterString"/>
            <element name="linearGeometry"
type="GM_Curve"/>
        </sequence>
        <attributeGroup ref="IM_ObjectIdentification"/>
    </complexType>
```

-not accepted by the OGC ”GML” community – A new ISO/TC211 work item proposal has been accepted to create a new harmonized version of -GML and ISO 19118 (could be based on XMI 2.x ?)

OGC GML2.0 schema example

```
<complexType name="RiverType">
    <complexContent>
      <extension base="gml:AbstractFeatureType">
          <sequence>
             <element ref="gml:centerLineOf"/>
          </sequence>
      </extension>
</complexContent></complexType>
<complexType name="RoadType">
   <complexContent>
      <extension base="gml:AbstractFeatureType">
         <sequence>
             <element name="linearGeometry" type="gml:LineStringPropertyType"/>
             <element name="classification" type="string"/>
             <element name="number" type="string"/>
         </sequence>
      </extension>
</complexContent> </complexType>
```

OpenGIS Web Services



OGC Web Services

Currently being done as XML request and response documents – specified by DTD and/or XML Schema. No platform independent UML models.

This is doable – but currently not viewed as necessary or initially feasible or useful.

Work to specify platform indepedent UML models is viewed as documentation ”clean-up” work – to be done by an ”idealistic” Documentation team – as the implementation specification group do not have the tools and expertise to do this. I.e. To be done in the process of submitting the models to the ISO191XX standardisation process.

Experiences from use of UML for ISO/TC211 and OpenGIS standards

•Example of UML profile to use UML for normative standard specifications, including UML->XML mapping

• Introduction of basic types for UML implementation neutral models

•Specifying mandatory, optional – using multiplicity 0..*, Question on how to express optionality of associations and attributes (supporting NULL and EMPTY)

• Stereotypes for CodeList, Union and Leaf (Package)
• ISO terminology comments on UML term definitions

•Question on expressing extensible enumerations

Lessons learned, ISO/TC211, OGC

-Need to have rules for well-defined and precise UML models (ISO 19103 – Conceptual Schema Language)

-Need to have automatic encoding of models into XML and other representations (i.e binary, proprietary) (ISO 19118 - Encoding), OGC GML

- Need to have an approach for service modeling for platform independent and platform specific models (ISO 19119 - Services)

- Neeed to have rules for how to do application specific modeling (ISO 19109 – Rules for application schema)

-Need to have tool-support (?) and tool-neutral diagram interchange format (?) – to give a development and usage advantage

-Need to have knowledge and resources to do the appropriate UML modeling (?)

-Need to manage integrated use of large models

- Need to go from current Model Harmonisation Team (ISO) and Documentation committee (OGC) – to use UML as the initial specification approach

Conclusion

To support ISO/TC211 and OGC and other similar domain standardisation organisations, OMG should as soon as possible produce the following:

- **Well defined rules and tools for creating platform-independent service and information models**
- **Well defined rules and tools for mappings to platform-specific models for the most important platforms: Web services/XML, CORBA, J2EE/EJB, SQL, ...**
- **A version of XMI (2.0?) that can produce human readable (HUTN) XML – similar to the handcreated XML schema specifications currently being made – (necessary to be accepted in the ”XML” communities)**
- **A tool-independent model diagram interchange format that can be used to support interoperability between multiple UML tools (the diagram interchange RFP!)**